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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/160,965	09/25/1998	SHAU-LIN SHUE	TSMC97-542/9	6951

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EXAMINER

KIELIN, ERIK J

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 02/03/2003

27

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/160,965

Applicant(s)

SHUE ET AL.

Examiner

Erik Kielin

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 18 November 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4,6 and 10-12 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,2,4,6 and 10-12 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☒ The proposed drawing correction filed on 18 November 2002 is: a) ☒ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION***Drawings***

1. The proposed drawing correction and/or the proposed substitute sheets of drawings, filed on 18 November 2002 have been approved. A proper drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The correction to the drawings will not be held in abeyance.

INFORMATION ON HOW TO EFFECT DRAWING CHANGES**1. Correction of Informalities -- 37 CFR 1.85**

New corrected drawings must be filed with the changes incorporated therein. Identifying indicia, if provided, should include the title of the invention, inventor's name, and application number, or docket number (if any) if an application number has not been assigned to the application. If this information is provided, it must be placed on the front of each sheet and centered within the top margin. If corrected drawings are required in a Notice of Allowability (PTOL-37), the new drawings **MUST** be filed within the **THREE MONTH** shortened statutory period set for reply in the "Notice of Allowability." Extensions of time may NOT be obtained under the provisions of 37 CFR 1.136 for filing the corrected drawings after the mailing of a Notice of Allowability. The drawings should be filed as a separate paper with a transmittal letter addressed to the Official Draftsperson.

2. Corrections other than Informalities Noted by Draftsperson on form PTO-948.

All changes to the drawings, other than informalities noted by the Draftsperson, **MUST** be made in the same manner as above except that, normally, a highlighted (preferably red ink) sketch of the changes to be incorporated into the new drawings **MUST** be approved by the examiner before the application will be allowed. No changes will be permitted to be made, other than correction of informalities, unless the examiner has approved the proposed changes.

Timing of Corrections

Applicant is required to submit acceptable corrected drawings within the time period set in the Office action. See 37 CFR 1.185(a). Failure to take corrective action within the set (or extended) period will result in **ABANDONMENT** of the application.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-2, and 4, 6, 10-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Lin** (US 6,093,656) in view of **Rathore et al.** (US 6,069,068) and **Datta et al.** (US 5,567,300).

Lin discloses the silicon substrate 12, the damascene trenches 13, 14 in a dielectric layer, the barrier metal layer (column 3, lines 17-23); the copper layer 20 (or “conductor,” claim 1); the reverse tone photoresist mask 26 which covers the copper in the trenches (column 3, lines 32-57; Fig. 3) --as further limited by instant claim 10; etching the exposed copper portions down to the silicon using a wet etch (Fig. 4; column 4, lines 15-21); stripping the photoresist (column 4, lines 22-25); planarizing the copper by CMP (column 4, lines 27-29). See also columns 1-4 and all figures.

Lin does not (1) specifically use the terminology, “dual damascene” or show a dual damascene structure in the figures, (2) does not specifically state that the disclosed “blanket copper deposition” (column 3, line 24) is electroplating on a seed layer; (3) reverse current electroplating; or (4) the cap layer.

Regarding (1), aside from it being known in the art that dual damascene (as opposed to single damascene) is also subject to dishing during metal planarization and for the same reasons, **Lin**’s claim 1 indicates the damascene, dielectric trenches have “at least two levels of elevation.”

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A third level of elevation would clearly yield a dual damascene trench structure. Therefore, **Lin** implicitly defines the invention for dual damascene. Note that it has been held that “[I]n considering the disclosure of a reference, it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom.” *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968) See also *In re Lamberti*, 545 F.2d 747, 750, 192 USPQ 278, 280 (CCPA 1976). Therefore, dual damascene is at least implicitly disclosed as being incorporated both in **Lin**’s inclusive claim language and in that fact that dual damascene is notoriously well known in the art, especially as defined in the **Lin** claims.

Regarding (2) and (4), although **Lin** does not specifically state electroplating is used for filling, **Lin** does teach that the blanket deposition of copper “could be done in a number of different ways...” (column 3, lines 23-27). **Rathore** teaches that it is known in the art to fill a dual damascene pattern using electroplating of copper on the stack consisting of adhesive layer 5, barrier layer 6, and seed layer 8 followed by planarization of the electroplated copper layer 9 and said stack (column 2, lines 45-59; Fig. 1a) and finally depositing a cap layer 7, 10 to seal the copper. (See Figs. 6b-6d.) Note also the **Rathore** states that “electroplating of copper **requires** a copper seed layer” (column 2, lines 3-5; emphasis added).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use any conventional copper electroplating on a required seed layer for the reason given in **Lin** because **Lin** teaches blanket depositing which clearly indicates to one of ordinary skill that **any** blanket depositing method is appropriate, such as the electroplating of **Rathore**.

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It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the cap layer for the reasons indicated in **Rathore**, to beneficially seal the copper layer, as noted.

Regarding (3), **Datta** et al. and references cited therein teach the benefits of reverse current electroplating for the purpose of removing unwanted metal -- particularly copper -- regions for the purpose of planarizing (sections entitled "Planarization is desirable for two reasons" and "There are various planarization methods").

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify **Lin** in view of **Datta** for the reasons given in **Datta**.

Regarding claim 4, in claim 1 of **Lin**, the layer 20 is limited to only "conductors" and therefore makes the use of any of Applicant's claimed conductors obvious. It has been held that selection of a known material based on its suitability for its intended use is *prima facie* obvious.

Regarding claim 6, **Lin** does not indicate that the dielectric is silicon oxide, but it is known to use silicon oxide for the dielectric in damascene processes and is therefore obvious to one of ordinary skill to use as a matter of routine material choice. See *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See also *In re LESHIN*, 125 USPQ 416 (CCPA 1960). The choice of silicon oxide for Lin's dielectric; Au, Al, with, Ti, or Ag for Lin's conductor; and are obvious as amounting obvious material choice, well within the purview of those of ordinary skill, as per the precedent above.

Regarding claims 11-12, **Lin** makes clear the inherency of or alternatively suggests Applicant's "critical dimensions" in the **Lin** discussion of the reverse tone photoresist mask. The choice of critical dimensions is obvious as a matter of routine optimization. These claims are

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prima facie obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious).

Response to Arguments

4. Applicant's arguments filed 18 November 2002 (Paper No. 6) have been fully considered but they are not persuasive.

As an initial matter, Applicant asserts that Examiner did not respond to Applicant's arguments presented in Paper No. 23 (filed 8 July 2002), which only complete that which Applicant was arguing in Applicant's arguments presented in Paper Nos. 17 and/or 19 (filed 24 January 2002 and 6 May 2002, respectively). Applicant's arguments have been essentially the same in Paper Nos. 17, 19, 23 (which only indicated from where the arguments in Paper no 19 came from) and now, by Applicant's own admission in Paper No. 28 are "THE EXACT RESPONSES GIVEN BY APPLICANT IN HIS REPLY OF APRIL 23, 2002, and filed by the PTO on 06 May 2002." (Emphasis in original.) Examiner respectfully asserts that each of these arguments has already been addressed in the previous Office actions of 26 February 2002 (Paper No. 18), and 12 August 2002 (Paper No. 24).

In the paragraph bridging pages 3 and 4, Applicant admits that there are "similarities with regard to (1)" to which Examiner believes that Applicant is referring to the "(1)" above in the rejection. Examiner asserts that the referenced information in (1) above is anticipated by the Lin reference alone because, as noted above, the difference is merely one of terminology.

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Applicant further argues in the bridging paragraph with regard to item labeled “(2)” above in the rejection, that the Lin statement “that the blanket deposition of copper ‘could be done in a number of different ways...’ is a blanket statement but does not teach anything.” Examiner expressly disagrees. It specifically tells those of ordinary skill in the art that (1) “a number of different ways” are appropriate for deposition of copper which implicitly means any art known method such as the notoriously well known electroplating, and (2) that the invention of Lin is not to be limited by the exemplary method indicated therein. Moreover, Rathore was provided at least to show copper filling by electroplating and planarization for multilevel interconnect, making its combination with Lin who discloses global deposition and planarization of multilevel interconnections appropriate at Lin’s suggestion that any method may be used. Note that the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985).

On p. 4, penultimate paragraph, Applicant argues that the cap layer is unique. Examiner respectfully disagrees. The capping layer in no way affects the planarization because it occurs after the planarization and can therefore not have any causal impact. The cause necessarily precedes the effect. Nonetheless, Rathore teaches the capping layer, making any argument in this regard moot. Examiner, accordingly, disagrees that the cap layer contributes novelty or non-obviousness because capping layers over copper are notoriously well known and have no impact on the method of planarization, which is the object of the instant invention.

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On p. 4, last paragraph, Applicant admits that Datta teaches reverse electroplating but argues that Datta does not teach the use of photoresist or reverse-tone photoresist mask in conjunction with the reverse current electroplating. The reverse tone photoresist mask 26 is already taught in Lin. There is no teaching in either of Lin or Datta that reverse current electroplating cannot be used in conjunction with a photoresist mask of some kind. Moreover, both Lin and Datta are drawn to planarization of multilevel copper metallization and therefore are directed to same process. Moreover, Datta teaches many benefits for using reverse current electroplating to planarize copper metallization, as noted above in the rejection. (See at least the Abstract of Datta.) Accordingly, one of ordinary skill has the express motivation to apply reverse current electroplating to the planarizing in Lin, for the reasons indicated in Datta. Note that the fact that applicant has recognized another advantage which would flow naturally from following the suggestion of the prior art cannot be the basis for patentability when the differences would otherwise be obvious. See *Ex parte Obiaya*, 227 USPQ 58, 60 (Bd. Pat. App. & Inter. 1985). Accordingly, the combination is believed to be proper.

On p. 5, first paragraph, Applicant argues that Examiner has used hindsight reasoning. In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

In the paragraph bridging pages 5-6, Applicant argues that the Lin does not teach the critical dimension of the photoresist mask. Examiner respectfully asserts, as in the rejection above, that one of ordinary skill in the art could would, with undue experimentation and a reasonable expectation of success, determine the critical dimension for the reverse tone photoresist mask by routine optimization, based upon the express teaching in Lin to use the reverse tone photoresist mask.

Moreover, Applicant's statements regarding the Lin statement that the metal deposition could be done in a number of different ways, is "like saying that 'all roads lead to Rome' but it does not tell one how to get there" (p. 3, last paragraph), and is "a bit like saying Brownian motion will get you to Rome" (p. 6, middle paragraph) are *non-sequitur* analogies to the Lin statement. Rather the Lin statement that a number of different metal deposition methods may be used to fill the openings in the dielectrics layer is more like stating to those of ordinary skill (e.g. Romans or Italians, in general) to use known routes to get to Rome, which could easily be found on a map (i.e. a secondary reference at the express suggestion of the primary reference). In other words, Lin states that known metal deposition methods (known routes to Rome) will operate in the metal filling step and are thereby included in the invention of Lin. Rathore (like the map to Rome) indicates that electroplating is one such known metal filling method.

In Applicant's analogy, on the other hand, Brownian motion has nothing to do whatever with travel to anywhere, much less to a specific location (i.e. is not a map to Rome). Brownian motion describes the *random* motion of molecules due to thermal energy; therefore, no specific endpoint is suggested by such random motion, and accordingly has nothing whatever to do with travel to a *specific* location, such as to Rome. Moreover, the suggestion to take a road to Rome is

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not a suggestion to wander around randomly. For these reasons, the applied analogies are not directed to the express suggestion in Lin to use other *known* metal deposition methods to get the *shown result* of metal-filled openings. Examiner respectfully asserts that one of ordinary skill would not be perplexed by the express suggestion to use other known metal deposition methods, but would instead know exactly to go to any of several standard references showing metal filling of openings and use such methods with a reasonable expectation of success, at the express suggestion to do so in Lin.

For these reasons, Applicant's arguments are not found persuasive.

Conclusion

5. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



Erik Kielin
February 1, 2003